

ABSTRACT

An optical system includes multiple cubic crystalline optical elements aligned along a common optical axis and having their crystal lattices oriented with respect to each other to minimize the effects of intrinsic birefringence and produce a system with reduced retardance. The optical system may be a refractive or catadioptric system having a high numerical aperture and using light with a wavelength at or below 248 nanometers. The net retardance of the system is less than the sum of the retardance contributions of the respective optical elements as the elements are oriented such that the intrinsic birefringences of the individual elements cancel each other out. In one embodiment, two [110] cubic crystalline optical elements are clocked with respect to one another and used in conjunction with a [100] cubic crystalline optical element to reduce retardance. Various birefringent elements, wave plates, and combinations thereof provide additional correction for residual retardance and wavefront aberrations. The optical system may be used in a photolithography tool to pattern substrates such as semiconductor substrates and thereby produce semiconductor devices.